

Flowers and insects. IV.

CHARLES ROBERTSON.

*Baptisia leucantha* Torr. & Gr.—The flowers are arranged in long, loose, erect racemes, and are white, except a broad purple streak on the base of the banner, which forms a nectar-guide. The stamens are distinct, and bees insert their proboscides between the filaments of the upper ones. The anthers dehisce in succession. Accordingly bees visit each flower several times to gather the pollen. After the wings and keel have been depressed by an insect resting upon them, they promptly return to their former position, concealing the stamens and pistil.

The calyx is from 8 to 9 mm. deep, which alone would restrict the visitors to the longest tongues. The calyx further tends to exclude short tongues by clasping the petals and holding them so that they are not easily forced apart. Then the banner is strengthened by three longitudinal folds—a median one where it clasps the wing and keel petals, and two lateral ones formed by the lobes being reflexed upon the central portion. The banner thus forcibly resists any upward pressure. On account of the depth of the calyx and the large size and rigidity of the petals, only the largest and strongest bees can force their way in. The flowers are visited very abundantly for honey and pollen by *Bombus americanorum* F. ♂. I know of no other flower in my neighborhood which seems to depend so exclusively on a single species of humble bee. Once I saw a butterfly, *Callidryas eubule* L., thrusting its proboscis under the banner, but, although it could reach the nectar, it would be by no means certain to touch the anthers or stigma.

*Psoralea Onobrychis* Nutt.<sup>1</sup>—The plants grow in large patches and bear many racemes of blue flowers, which are very attractive to bees. Greenish lines on the banner form path-finders. The wings and keel are depressed together, and return so as to cover the stamens. The stigma is raised considerably above the anthers and so strikes the bee in ad-

<sup>1</sup>On this species see Fœrste: BOT. GAZ., XIII, 152.

vance of them. The calyx tube is about two mm. deep, so that small bees which know how to force their way into the flower can reach the nectar. The flowers are sought by many insects, especially bees of the genus *Megachile*.

Visitors (7 days, June 26–July 11): Hymenoptera—*Apidae*: (1) *Apis mellifica* L. ♂, s.; (2) *Ceratina dupla* Say ♀, s.; (3) *Megachile* sp. ♂ ♀, s. and c. p.; (4) *M. addenda* Cr. ♂, s.; (5) *M. mendica* Cr. ♀, s. and c. p., ab.; (6) *M. brevis* Say ♂ ♀, s. and c. p., ab.; (7) *M. perbrevis* Cr. ♂, s.; (8) *Anthidium emarginatum* Say ♂, s.; (9) *Alcidamea producta* Cr. ♀, s. and c. p.; (10) *Osmia distincta* Cr. ♀, s.; (11) *Cælioxys 8-dentata* Say ♀, s.; (12) *Calliopsis audreniformis* Sm. ♂ ♀, s. and c. p., ab. *Audrenidae*: (13) *Agapostemon radiatus* Say ♀, s. and c. p.; (14) *Halictus coriaceus* Sm. ♀, s.; (15) *H. Lerouxii* St. Farg. ♀, s.; (16) *H. flavipes* F. ♂ ♀, s.; (17) *Colletes* sp. ♂, s. *Eumenidae*: (18) *Odynerus dorsalis* F., s.; (19) *O. arvensis* Sauss., s. *Sphecidae*: (20) *Priononyx atrata* St. Farg.; (21) *P. thomæ* F., both s.

Diptera—*Bombylidae*: (22) *Anthrax sinuosa* Wied.; (23) *A. parvicornis* Lw., both s.

Lepidoptera—*Rhopalocera*: (24) *Papilio philenor* L.; (25) *Pieris protodice* Bd.-Lec. *Noctuidae*: (26) *Anthæcia iagnarina* Gn., all 3 s.

*Amorpha canescens* Nutt.—The proterogyny of this plant and of *A. fruticosa* has been recorded by Beal.<sup>2</sup> Müller<sup>3</sup> has figured *A. fruticosa* and described its mechanism, confirming Beal's view in regard to proterogyny and adding that self-fertilization may occur in absence of insects. Meehan<sup>4</sup> also has observed the flowers, but while he recognized the fact that the pistil matures a day before the anthers, he holds that the flowers are self-fertilized, and that too after having observed that "the flowers seem very grateful to the pollen-gathering insects." He also considers the late enlargement of the banner as wholly superfluous, disregarding the fact that the real instrument of attraction is the whole inflorescence, and that anything which increases the conspicuousness of the spike is an advantage to all of the flowers.

Visitors (June 24–26 and 28): Hymenoptera—*Apidae*: (1) *Bombus americanorum* F. ♀ ♂, s. and c. p.; (2) *Ceratina dupla* Say ♀, s.; (3) *Megachile brevis* Say ♀, s. and c. p.:

<sup>2</sup> Am. Nat. I, 405.

<sup>3</sup> Weitere Beobachtungen, II, 244, and Pl. II and III, figs. 52–54.

<sup>4</sup> Proc. Acad. Sci. Phil., 1887, 329, 330. See also Delpino: Ult. osservazioni, I, 67, 68.

(4) *Alcidamea producta* Cr. ♀, s.; (5) *Andronicus cylindricus* Cr. ♀, c. p.; (6) *Heriades carinatum* Cr. ♀, c. p.; (7) *Cælixys 8-dentata* Say ♀, s.; (8) *Calliopsis audreniformis* Sm. ♀, s. *Audrenidæ*: (9) *Halictus* sp. ♂, s.; (10) *H. pilosus* Sm. ♀, s.; (11) *H. connexus* Cr. ♀, s. and c. p.; (12) *Prosopis affinis* Sm. ♀, f. p.; (13) *P. pygmæa* Cr. ♀, f. p. *Eumenidæ*: (14) *Eumenes fraternus* Say, s. *Sphécidæ*: (15) *Ammophila intercepta* St. Farg.; (16) *A. vulgaris* Cr.; (17) *Priononyx atrata* St. Farg., all 3 s.

Diptera—*Syrphidæ*: (18) *Paragus bicolor* F.; (19) *Tropidia mamillata* Lw., both f. p.

Coleoptera—*Chrysomelidæ*: (20) *Diabrotica 12-punctata* Oliv.; (21) *D. atripennis* Say. *Meloidæ*: (22) *Macrobasis unicolor* Kby., all f. p.

*Petalostemon violaceus* Mx.—The plants grow in rather large patches, the stems being terminated by several close spikes of rose-purple flowers, which I regard as proterandrous. The corolla is nearly regular, and it seems as if it might as well be quite so, as far as its effect upon insects is concerned. Indeed, the calyx has more to do with determining the character of the visitors. The number of wasps is far greater than would be expected on a flower of the complicated structure we find in most Papilionaceæ. The organs are so exposed that the stigma is pollinated and the pollen is collected by bees crawling around the spikes. The nectar is not very deeply seated, the calyx being 3 to 4 mm. deep; but the flowers are visited more frequently for pollen than for nectar.

Visitors (7 days, July 5-30): Hymenoptera—*Apidae*: (1) *Apis mellifica* L. ♂, s. and c. p.; (2) *Bombus virginicus* Oliv. ♂, s. and c. p.; (3) *B. separatus* Cr. ♂ ♀ ♂, s. and c. p.; (4) *B. americanorum* F. ♀ ♂, s. and c. p., ab.; (5) *B. scutellaris* Cr. ♂, s. and c. p.; (6) *Melissodes obliqua* Say ♂ ♀, s. and c. p.; (7) *M. bimaculata* St. Farg. ♂, s.; (8) *Ceratina dupla* Say ♀, s. and c. p.<sup>5</sup>; (9) *Megachile brevis* Say ♀, s. and c. p., ab.; (10) *M. inimica* Cr. ♀, s. and c. p.; (11) *Andronicus cylindricus* Cr. ♀, s. and c. p.; (12) *Cælixys 8-dentata* Say, s.; (13) *Epeolus remigatus* F. ♀, s.; (14) *E. lunatus* Say ♂ ♀, s., ab. *Audrenidæ*: (15) *Agapostemon nigricornis* F. ♀, s. and c. p., ab.; (16) *Augochlora pura* Say ♀, c. p.; (17) *A. lucidula* Sm. ♀, s.; (18) *Halictus* sp. ♀, c. p.; (19) *H.*

<sup>5</sup>This bee is said to be destitute of polleniferous organs, but it certainly has a thin scopa and I have often seen it collecting pollen. In Am. Nat. XIII, 430, Prof. Trelease mentions having seen it collecting pollen of *Lobelia syphilitica*.

*parallelus* Say ♂ ♀, s. and c. p., ab.; (20) *H. flavipes* F. ♀, s. and c. p., ab.; (21) *H. pilosus* Sm. ♀, c. p.; (22) *H. connexus* Cr. ♀, c. p.; (23, 24) *Colletes* spp. ♀, s. and c. p. *Eumenidae*: (25) *Eumenes fraternus* Say, s. *Bembecidae*: (26) *Bembex nubillipennis* Cr. s. *Sphécidae*: (27) *Ammophila procera* Klug.; (28) *A. intercepta* St. Farg.; (29) *Sphex ichneumonea* L.; (30) *Priononyx atrata* St. Farg.—all s. *Scoliidae*: (31) *Elis plumipes* Dru., s.

Diptera—*Sarcophagidae*: (32) *Sarcophaga* sp.

Lepidoptera—*Rhopalocera*: (33) *Lycaena comyntas* Godt.; (34) *Colias caesonia* Stoll; (35) *C. philodice* Godt.; (36) *Pholisora catullus* F.—all s.

Coleoptera—*Meloidae*: (37) *Epicauta pennsylvanica* De G.; (38) *E. trichrus* Pall.—both s. and f. p.

Hemiptera—*Capsidae*: (39) *Calocoris rapidus* Say, s. *Pentatomidae*: (40) *Euschistus variolarius* P. B., s.

*Tephrosia Virginiana* Pers.—The banner is light yellow, the wings and keel are pink. The anthers dehisce in the keel, and when the keel is depressed the pollen is carried out on a brush of hairs which covers the upper edge of the style. The stigma itself is covered with pollen at first and aids in carrying it out so as to strike the bee, but it is probably not receptive until after the pollen has been removed and its surface has been rubbed, as in the case of *Anthyllis*, etc.<sup>6</sup> The flowers are visited for honey and pollen by *Megachile brevis* Say ♀.

*Desmodium*.—The behavior of this flower was described by Bessey in the case of *D. sessilifolium*,<sup>7</sup> and by Foerste in *D. canescens*.<sup>8</sup> The keel incloses the stamens and pistil, and is held in position by two processes on the base of the banner. The keel has such a strong tendency to fly down that it bends the inclosed organs downward with it; the stamens and pistil, therefore, have a strong tendency to fly up. The wings also are held by the banner, and are so closely united with the keel that when one of them is released the keel is released with it. The wings thus act as triggers by which the flower is discharged; but the discharge may also be effected by raising the banner, or by forcing the banner and keel apart.

<sup>6</sup> See Müller, *Fertilization of Flowers*, 173.

<sup>7</sup> *Am. Nat.* XIX, 711-713, figs. 1-4.

<sup>8</sup> *Bot. Gazette*, XIII, 152.

The filaments are expanded at the tips and are turned outward a little, so as to form a little basket in which the pollen is received when discharged, and which aids in throwing the pollen when the trap is sprung.

Foerste says, "The fact that the tenth stamen is free is *a priori* evidence of the existence of honey." Bessey seems to have supposed that nectar was present and that the spots on the base of the banner were nectar-guides. But the stamen tube is closed below and nectar is wanting; the flower belongs with such flowers as *Genista tinctoria* and *Sarothamnus scoparius*,<sup>9</sup> which are adapted to be visited only by pollen-collecting bees, and which permit only one visit.

When a bee lights upon the flower it thrusts its head under the base of the banner while with its legs it forces one or both of the wings outward and downward so as to dislodge it from the banner. This frees the keel, which snaps down violently. The column, being in turn freed from the keel, flies up and hurls the pollen against the ventral surface of the bee.

*Desmodium Canadense* DC.—This is the largest flowered species, and can only be exploded easily by the largest bees. Consequently, humble bees are more abundant than on any of the other species.

Visitors (July 20, Aug. 15): *Apidae*: (1) *Bombus separatus* Cr. ♂; (2) *B. americanorum* F. ♂; (3) *Melissodes bimaculata* St. Farg. ♀; (4) *Megachile brevis* Say ♀, rare, and only open the flower with difficulty.

*Desmodium cuspidatum* T. & G.—Visitors (Aug. 13 and 22): *Apidae*: (1) *Bombus americanorum* F. ♂; (2) *Melissodes bimaculata* St. Farg. ♀; (3) *Megachile brevis* Say ♀.

*Desmodium Dillenii* Darl.—Visited by *Bombus americanorum* F. ♂.

*Desmodium paniculatum* DC.—Visitors (4 days, Aug. 8–Sept. 10): *Apidae*: (1) *Bombus americanorum* F. ♂; (2) *Melissodes bimaculata* St. Farg. ♀; (3) *Megachile brevis* Say ♀; (4) *M. mendica* Cr. ♀; (5) *Calliopsis audreniformis* Sm. ♀.

*Desmodium sessilifolium* T. & G.—Visited by *Megachile brevis* Say ♀.

*Desmodium Marylandicum* Boott.—The small flowers of this plant are exploded by a little bee, *Calliopsis audreniformis* Sm. ♀.

We have observed that the flowers are adapted to the

<sup>9</sup>See Müller, Fertilization of Flowers.

pollen-collecting bees; so that, at the start, all male bees and all cuckoo-bees are excluded. Then the visitors must be intelligent enough to know how to snap the flowers and to keep from being frightened by their explosion. For this reason the visitors of *Desmodium* are the most intelligent of the genera to which they belong, or are at least more used to visiting flowers of complicated structure.

On the six species of *Desmodium* mentioned above there occur two species of *Bombus*, one of *Melissodes*, two of *Megachile* and one of *Calliopsis*. Of eight species of *Bombus* which occur in my neighborhood, *B. americanorum* is the most intelligent and the most important visitor of irregular flowers. This bee was seen on the flowers of four species, while *B. separatus* was seen only on *D. Canadense*. Of seven species of *Melissodes*, *M. bimaculata* is most common on irregular flowers, while the others occur more often on *Compositæ*. Most of twelve species of *Megachile* also limit their attentions to *Compositæ*, while *M. brevis* and *M. mendica* are common on irregular flowers. The same is true of the five species of *Calliopsis*, *C. audreniformis* being the only one observed on irregular flowers.

The larger flowered species also limit their visitors by the strength required to discharge them. Thus, *D. Canadense* is most abundantly visited by humble bees, since the smaller bees, like *Megachile*, can only snap them with difficulty. The little *Calliopsis audreniformis* is neither strong enough to spring the trap nor is it large enough to receive the pollen. But while the small bees are excluded from the large flowers, the large bees can easily discharge and receive the pollen of the smaller flowers. As a consequence, the smaller flowers, like *D. paniculatum*, are sought by a greater number of species. But the very small flowers of *D. Marylandicum* seem to depend exclusively upon *Calliopsis*.

*Carlinville, Ill.*

### Mycologic observations. I.

A. P. MORGAN.

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1. The winter season can not usually be considered very favorable to the growth of fungi; nevertheless during warm and mild rainy spells many kinds will be found growing. Aside from the woody and leathery forms which are peren-